# INSTRUCTION MANUAL

EMPIRE*

MICROWAVE IMPULSE
GENERATOR

MODELS IG-118A IG-118B
AND
IG-118C

RECEIVED
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METROLOGY

Gertsch*
EMPIRE*
Sensitive Research*
Panoramic*
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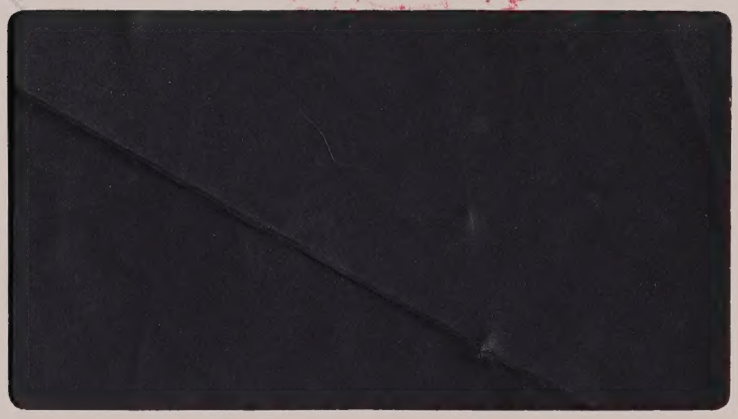
THE SINGER COMPANY • METRICS DIVISION



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MICROWAVE IMPULSE
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MODELS IG-118A IG-118B
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SERIAL NO. 516

Gertsch*
EMPIRE*
Sensitive Research*
Panoramic*
SINGER

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# WARRANTY

THE SINGER COMPANY, METRICS DIVISION, warrants each new instrument to be free from defects in material and workmanship, effective after delivery to the original purchaser as follows:

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*Sensitive Research** Electrical Indicating Instruments.....2 years

Other Electrical and Electronic Measuring Instruments.....1 year

Repair or replacement (at our option) without charge (F.O.B. factory) will be effected when our examination satisfactorily indicates that defects are due to workmanship or materials. Electron tubes, semiconductors, batteries, fuzes, lamps, thermoelements, and *RatioTran** potentiometers are excluded from warranty coverage. Warranty returns must first be authorized by the factory.

If the instrument or any portion thereof, has been abused, misused, damaged by accident or negligence, or if any serial number or seal has been removed or altered, the warranty is void.

This warranty is in lieu of all other obligations or liabilities expressed or implied and The Singer Company neither assumes, nor authorizes any person to assume for them, any other liability in connection with sales of instruments manufactured by The Singer Company, Metrics Division.

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## REPAIR AND MAINTENANCE

Instruments should be returned only on prior written authorization from the Singer Representative or the factory(1). Warranty repair will be made upon written request. Please provide the following information in order to expedite our processing of your instrument:

1. Model or Type
2. Serial Number
3. Description of trouble(2)
4. Test instruments used
5. Approximate date instrument was placed in operation
6. Approximate number of hours of use
7. Has maintenance action been previously requested?
8. Other comments

Upon receipt of this information our Service Department will send you service data or shipping instructions. Upon receipt of shipping instructions forward the instrument to the factory prepaid. If requested, an estimate of charges will be made before work begins.

(1) Contact Metrics Division, Bridgeport, Connecticut for *Commander**, *Empire**, *Panoramic**, and *Sensitive Research** instruments. Contact Metrics Division, Los Angeles, California for *Gertsch** instruments.

(2) Include data on symptoms, measurements taken, suspected location of trouble, maintenance action taken, and any other relevant data.

# ADDENDUM FOR IG-118C

## I. PURPOSE

The purpose of this addendum is to specify the differences between this unit and the IG-118A.

## II. ADDENDUM

The IG-118C contains a timer which must be set in order to turn on the equipment. Turn on the equipment as follows:

1. For typical unit turn-on procedure, refer to paragraph 2.2 in the manual. In addition to the instructions contained in paragraph 2.2, turn the unit on by turning the timer clockwise. When the timer is fully clockwise, the unit remains "on" for 30 seconds and then automatically turns off.

July 29, 1964

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# SECTION I

## GENERAL DESCRIPTION

### 1.1 Introduction

Empire Devices' Models IG-118A and IG-118B Impulse Generators are transistorized, compact, lightweight, portable instruments, capable of producing pulses in the fractional millimicrosecond region. These pulses, normally too short to be presented on an oscilloscope, produce an extremely broad spectrum.

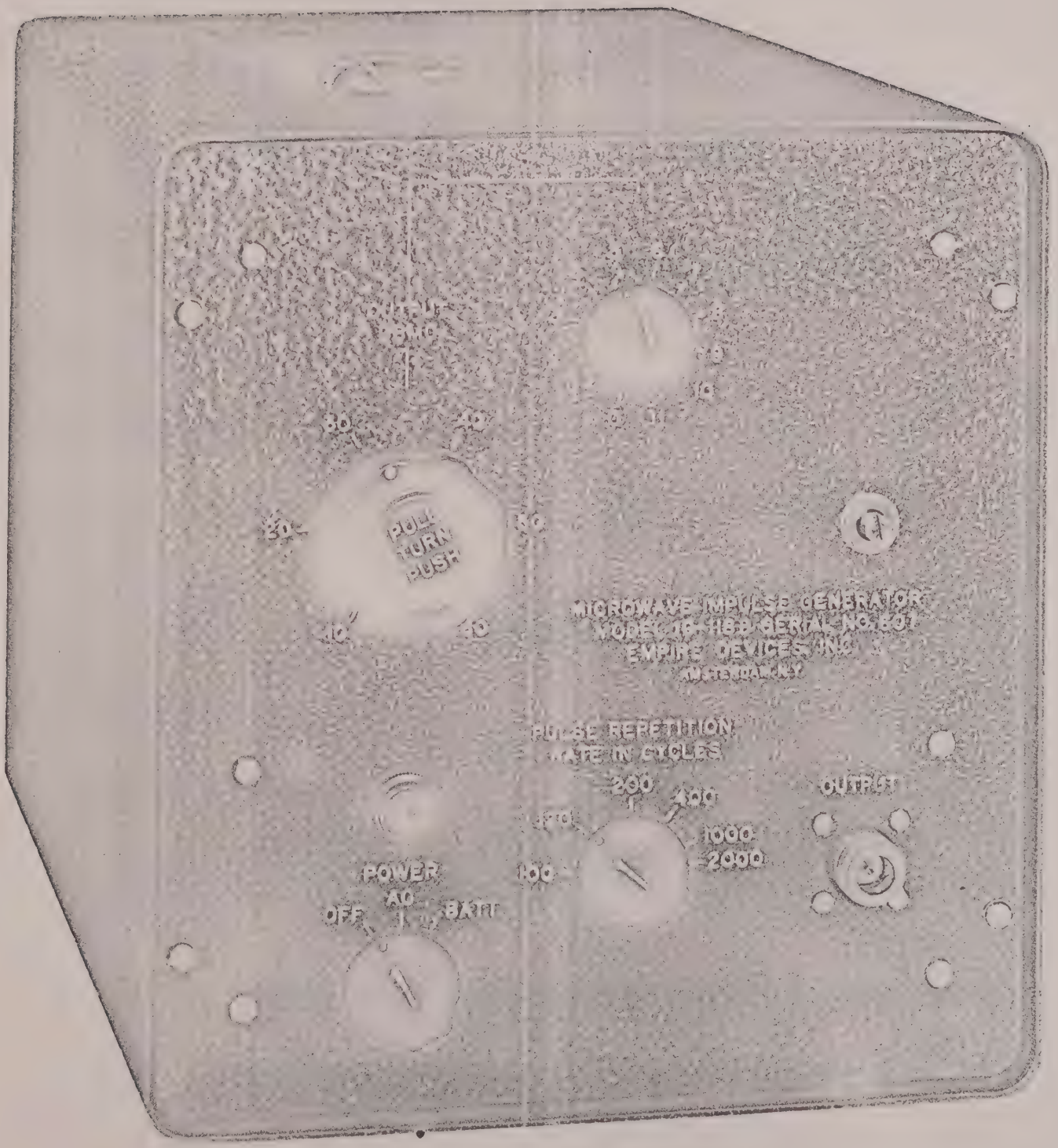
The instruments are designed to be operated from a 115 V AC power source or a 12 V DC battery. This permits the instruments to be used in the field as readily as in the laboratory. The impulse generators are capable of producing a known output level of broadband pulse energy, with excellent long time stability.

### 1.2 Applications

The Model IG-118A or IG-118B may be used as a calibrating standard for noise and field intensity meters; for the measurement of noise susceptibility of receivers; for bandwidth determination and receiver alignment. They may also be used for noise figure measurements; transient response studies; evaluation of spectrum analyzers; as a signal source for broadband amplifiers and for specific applications such as testing broadband ECM systems.

### 1.3 Technical Characteristics

| | |
|---|---|
| Frequency Spectrum: | 1,000 MC to 10,000 MC, flat within $\pm \frac{1}{2}$ DB. |
| Pulse Width: | .00005 microseconds ($5 \times 10^{-11}$ seconds). |
| Output Impedance: | 50 ohms. (Type N) |
| Output Level (Peak): | 71 DB above 1 microvolt per megacycle bandwidth (DBMC). IG-118A range adjustable over 11 DB in 1 DB steps; IG-118B range adjustable over 61 DB in 1 DB steps. |
| Pulse Polarity: | Automatically reverses. |
| Pulse Repetition Rate: | Continuously adjustable from 120 cycles to 2,000 cycles per second. |
| Power Requirements: | 115 volts, 50 to 4000 cps, 25 VA or 10 to 15 volts DC, 0.75 amp., nominal. |
| Size: | $8\frac{1}{4}$" wide x $9\frac{1}{4}$" high x 13 1/8" deep. |
| Weight: | IG-118A - 14 lbs.; IG-118B - 17 lbs. |


PULL
TURN
PUSH
MICROWAVE IMPULSE GENERATOR
EMPIRE DEVICES INC.
PULSE REPETITION
RATE IN CYCLES
200
400
1000
2000
OUTPUT
POWER
OFF

## SECTION II

## OPERATING INSTRUCTIONS

### 2.1 Operating Controls

| CONTROL | FUNCTION |
|---|---|
| POWER-OFF; AC; BATT. | Applies power to the instrument from either an AC source of 115 volts, 50-400 cps or a 12 volt DC battery. Indicator lamp directly above the switch is illuminated when power is applied. |
| PULSE REPETITION RATE IN CYCLES | Used to set the pulse repetition rate of the impulse generator. |
| OUTPUT - DBMC | Selects the desired level of the output signal. In the IG-118A, a single control selects an output range of 60 to 71 DBMC. In the IG-118B, two controls are used to select the range of 10 to 71 DBMC. |
| CONTACT ADJUST | This control optimizes the contact spacing and is used to compensate for normal wear of the contacts. |

### 2.2 Operating Procedure

a. To operate from an AC source of power, plug the line cord into a suitable outlet. Rotate the power switch to AC.

b. To operate from a DC source of power, do not plug in the AC line cord. Connect the battery to the terminals in the rear of the instrument. Observe polarity; that is, connect the positive lead to the red terminal. If the polarities are reversed, the instrument will not operate. Damage to the instrument due to reversed polarity is prevented by the use of a series diode.

c. Connect a 50-ohm coaxial cable from the output connector on the front panel to the device under test.

d. Adjust the output-DBMC controls to obtain the desired output level.

e. Adjust the PULSE REPETITION RATE IN CYCLES control for the desired pulse repetition rate. (Normally that which most nearly matches the PRR otherwise being received.)

f. The contact adjust control is factory-set to the proper position. To confirm that the setting is proper, connect the output terminal of the IG-118 to a receiver having an audio output and adjust the receiver gain and volume to obtain an audible tone. Rotate the contact adjust control fully clockwise; then, rotate it slowly counter-clockwise until the clearest tone is heard in the receiver.

## SECTION III

## THEORY OF OPERATION

The models IG-118A and IG-118B produce extremely short pulses which provide a uniform spectrum over the frequency range from 1,000 to 10,000 megacycles per second. The impulses are generated by the abrupt discharge of a charged section of coaxial line. Block diagrams of the impulse generators are shown in Figures 3-1 and 3-2.

The regulated power supply furnishes +6.3 volts to the transistor circuits of the impulse generators. The regulated supply is isolated from ground to permit grounding on either side. Two silicon diodes, CR1 and CR2, act as a full wave rectifier for the AC input voltage. Silicon diode CR3 is a polarity protective device, placed in the positive DC input line to protect the transistors in the event the battery is inadvertently reversed. Regulation is accomplished by means of a reference diode, CR4, a series regulating transistor, Q2, and an amplifier transistor, Q1. Potentiometer R3 is connected across the +6.3 volt output to provide a feedback voltage for comparison against the reference diode.

The rate at which the impulse generator drivers act to discharge the coaxial line is determined by the pulse repetition rate generator. This generator consists of two transistors, Q3 and Q4, operating as a free-running multivibrator. The repetition frequency is adjusted by means of the PULSE REPETITION RATE IN CYCLES control on the front panel. This control is a ganged, dual potentiometer, R6 and R7, which varies the time constant in the bias circuits of the transistors.

The impulse generator drivers, Q5 and Q6, produce a square wave at a frequency determined by the pulse repetition rate generator, which drives the mechanical vibrator. The 55 CPS square wave charging voltage produced by transistors Q7 and Q8 is applied through a charging resistor, thereby charging the coaxial line alternately positively and negatively. The mechanical vibrator discharges the line, at the pulse repetition rate, into a discharge line to produce the impulses.

Provision is made in both the IG-118A and IG-118B for controlling the output level. In the IG-118A, this is accomplished by a single OUTPUT-DBMC control, calibrated from 60 to 71 DBMC, located on the front panel. This switch controls a precision voltage divider connected between the secondary of the charging voltage transformer and the charging resistor, which is located in one contact arm of the mechanical vibrator. This control varies the charging voltage in 1 DB steps, thus controlling the output level over an 11 DB range.

The output level of the IG-118B is controlled by the combination of a voltage divider identical to that described above and an RF step attenuator. The voltage divider is calibrated from 0 to 11 DBMC. The RF step attenuator is calibrated from 10 to 60 DBMC. The sum of the two settings is the final output, thus providing adjustment from 10 to 71 DBMC in 1 DB steps. The RF step attenuator covers its range in six 10 DB steps. It is located between the impulse generator and the output terminal of the instrument.

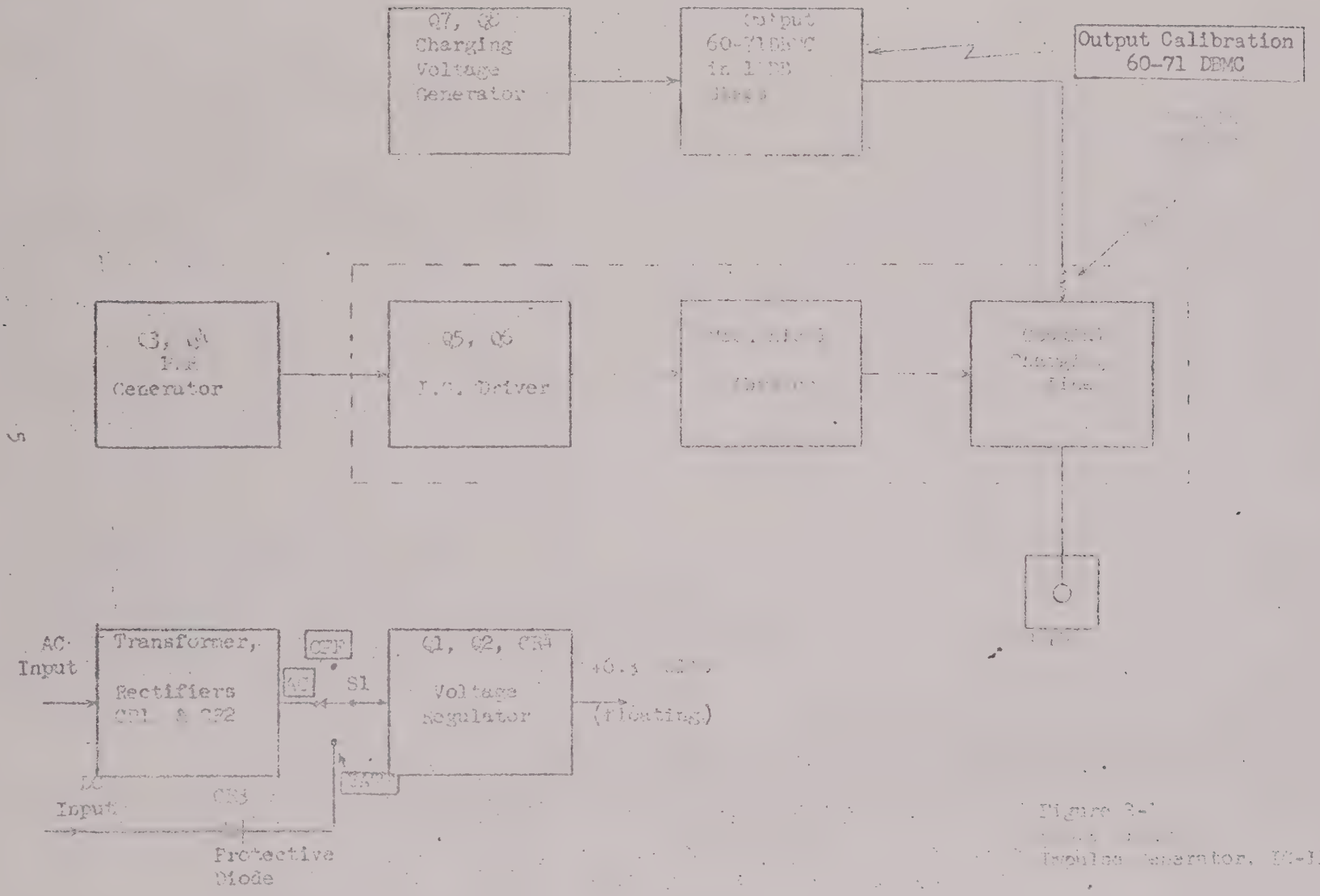



Figure 3-1

Impulse Generator, IG-11

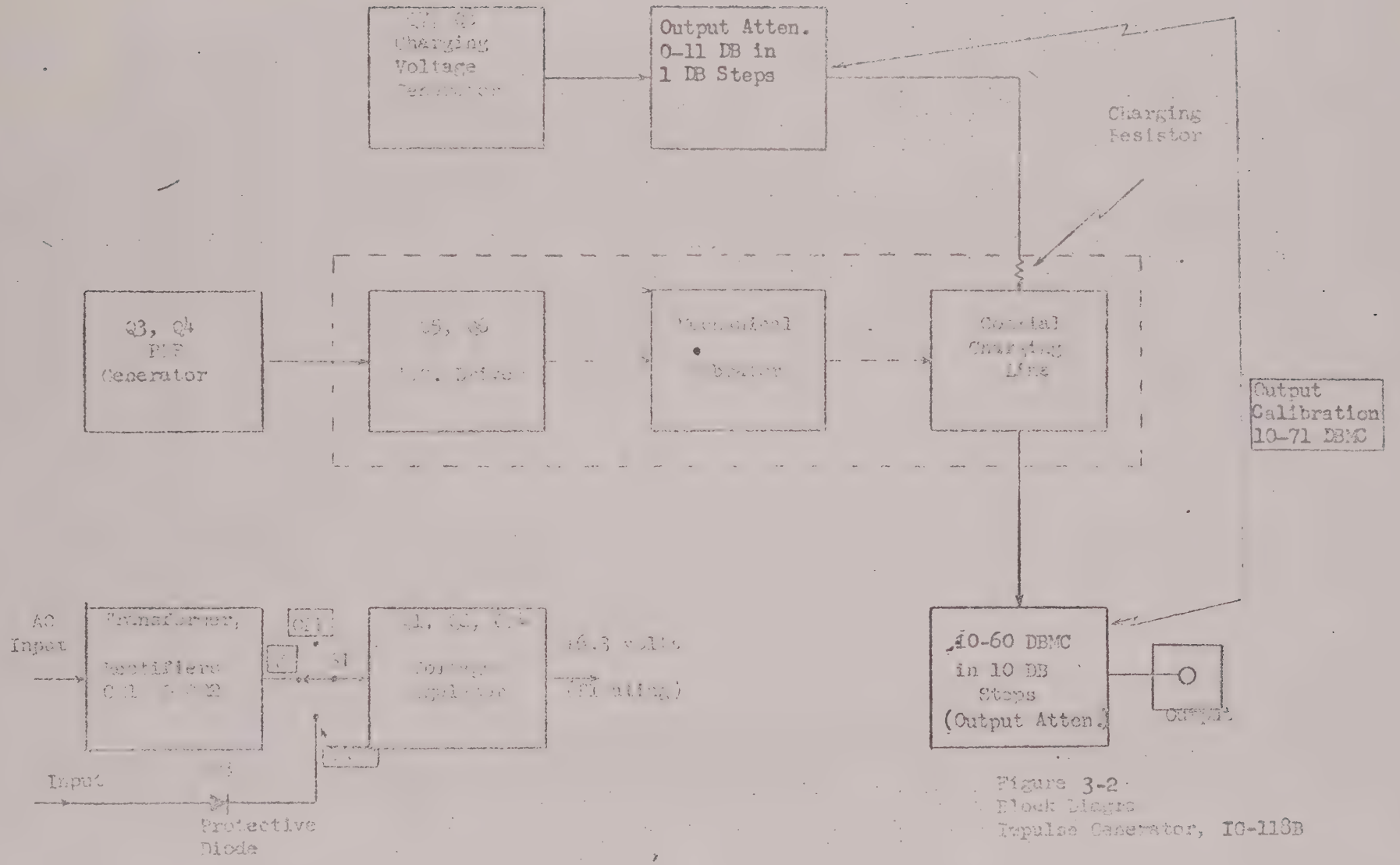



Figure 3-2
Block Diagram
Impulse Generator, IG-118B

## SECTION IV

## MAINTENANCE

### 4.1 Test and Adjustment Procedures

#### 4.1.1 Frequency Spectrum

a. Using the test set-up illustrated in Figure 4-1, complete the following steps to compare the amplitude level of the Impulse Generator with that of a pulse-modulated CW source.

b. Set the double pole-double throw coaxial switch to connect the Impulse Generator to the sensitive receiver.

c. Observe the output of the Impulse Generator on the panoramic display, and adjust the OUTPUT DBMC controls to obtain a reference reading.

d. Rotate the coaxial switch to connect the pulse-modulated signal generator to the sensitive receiver.

e. Tune the signal generator to the frequency of the receiver and adjust the power setting controls of the signal generator to calibrate its output.

f. Adjust the signal generator variable attenuator to obtain the same reference level as that obtained with the Impulse Generator step C above. The dial setting of the variable attenuator is an indication of the relative output spectrum of the Impulse Generator.

g. Follow the above procedure for test frequencies in whatever increments are desired.

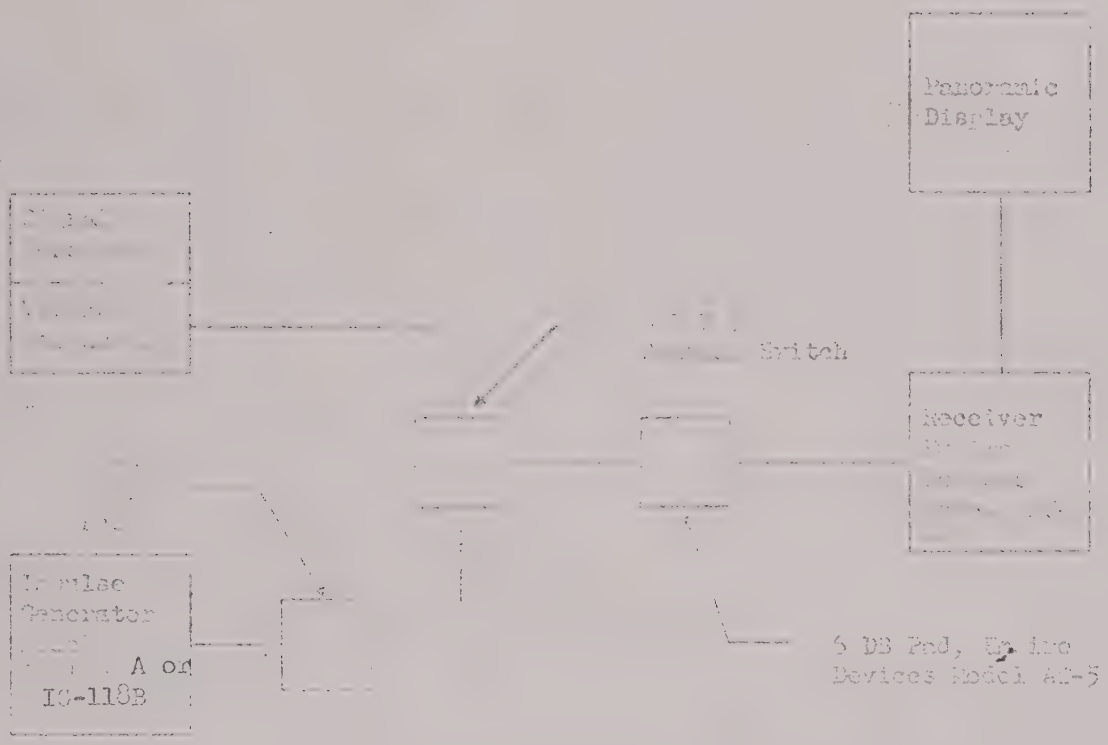
#### 4.1.2 Contact Behavior And Stability

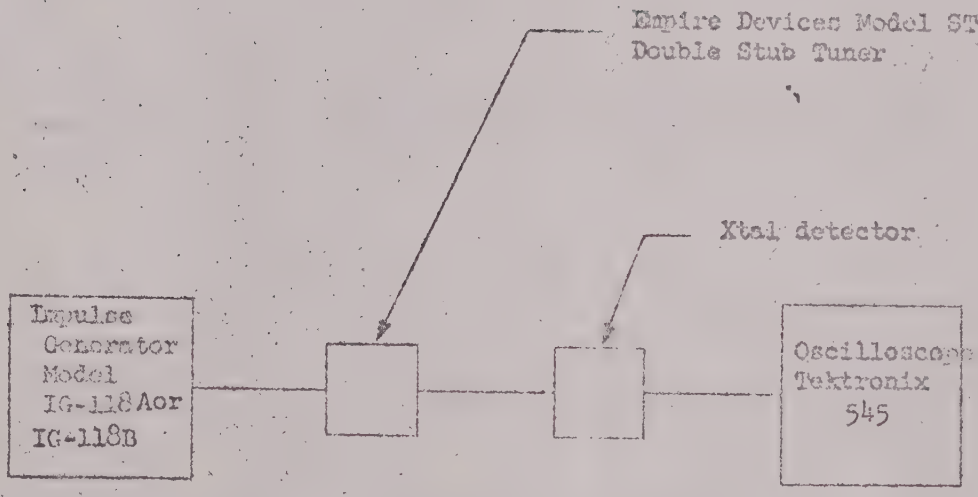
a. Connect the Impulse Generator through an Empire Devices Model ST-32-B Double Stub Tuner and a crystal detector, into a high speed oscilloscope such as a Tektronix Model 545 as shown in Figure 4-2.

b. Turn the CONTACT ADJUST control fully clockwise with a screwdriver, thus opening the contacts.

c. Adjust the PULSE REPETITION RATE IN CYCLES control to approximately 2000 CPS. At this time, the "buzzing" of the generator should be distinctly audible.

d. Watching the oscilloscope screen, slowly advance the CONTACT ADJUST control until an output appears on the screen similar to that illustrated in Figure 4-3 (A).


Panoramic
Display
Switch
Receiver
6 DB Pad, Engineered
Devices Model AT-5
A or
IC-118B




Test set-up for contact adjustment

Figure 4-2

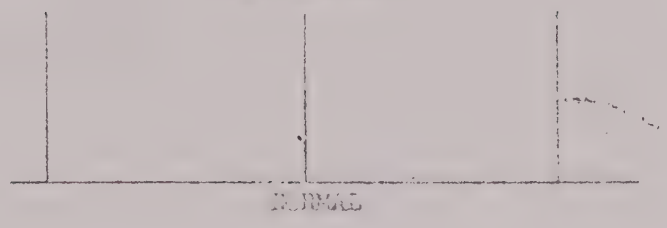


Fig. 4-3 (A)

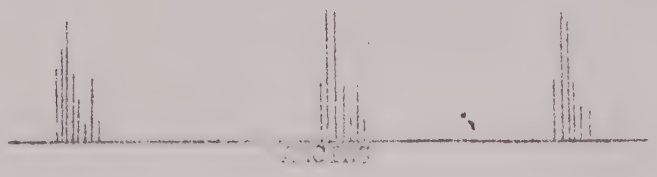


Fig. 4-3 (B)

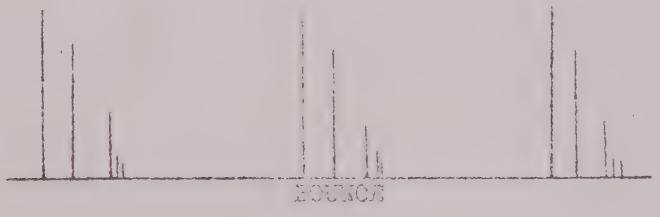


Fig. 4-3 (C)

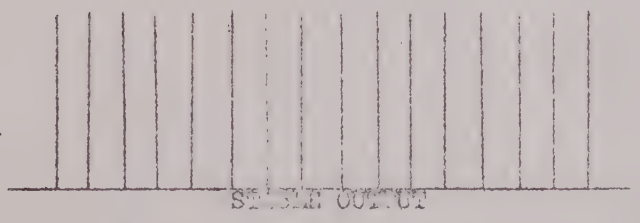


Fig. 4-3 (D)

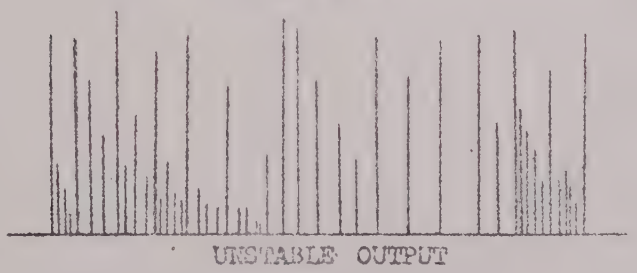


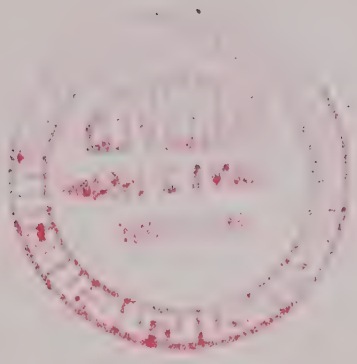
Fig. 4-3 (E)

NOTES:
A. Normal Contact Behavior
B. Arcing at Contacts: Contacts not Touching
C. Bouncing Contact: Contacts too Close
D. Stable Output: Damped Transducer
E. Unstable Output: Undamped Transducer

Figure 4-3

e. Vary the PULSE REPETITION RATE IN CYCLES control from 100 to 2000 and observe the oscilloscope for a clean output over this range.

Since it is impractical for the contacts to be continuously monitored by means of an oscilloscope, the operator should familiarize himself with the aural tone which accompanies a clean output and readjust the CONTACT ADJUST control for this tone whenever it is required.



# SECTION V

# SCHEMATIC DIAGRAMS

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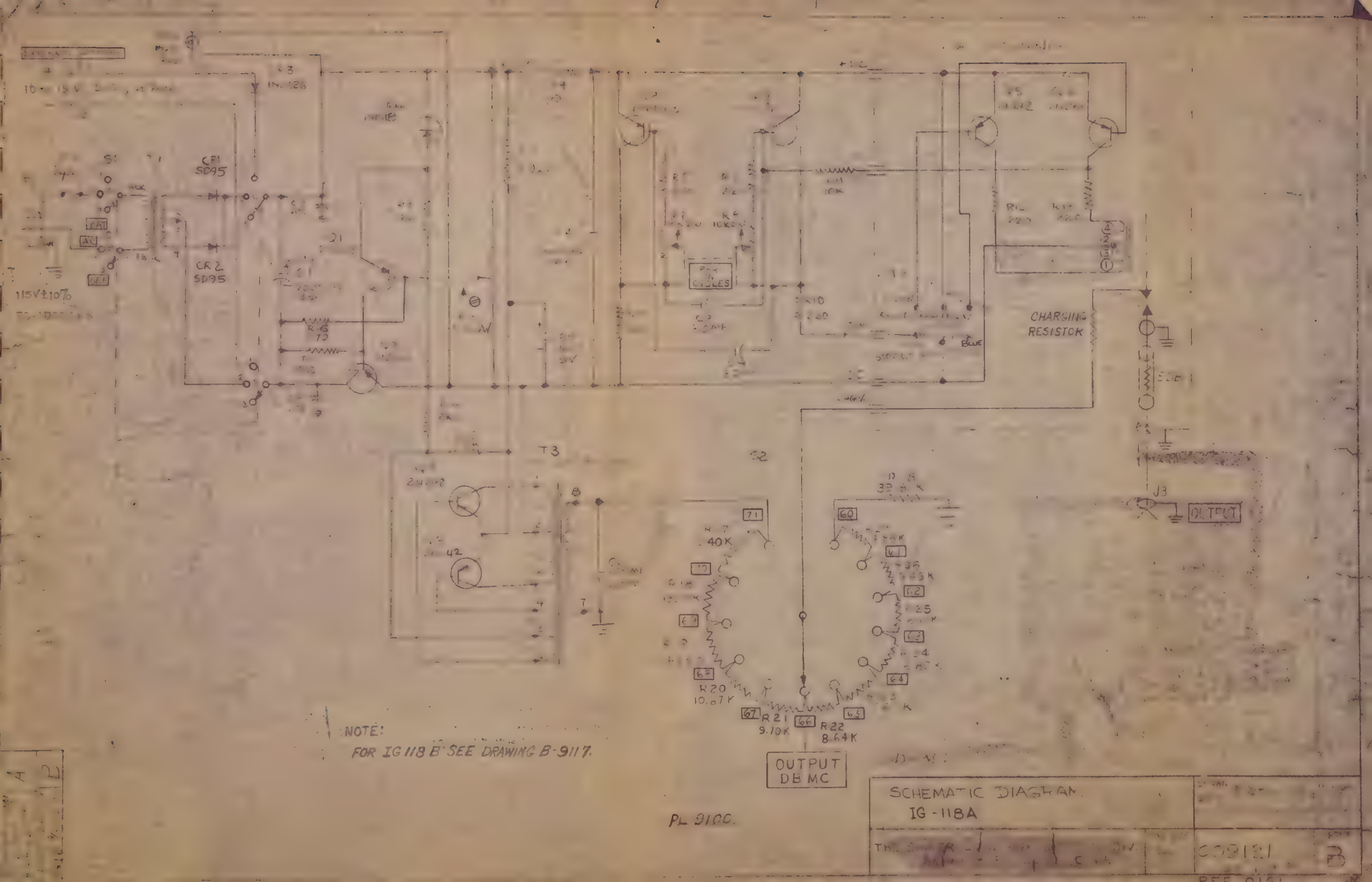
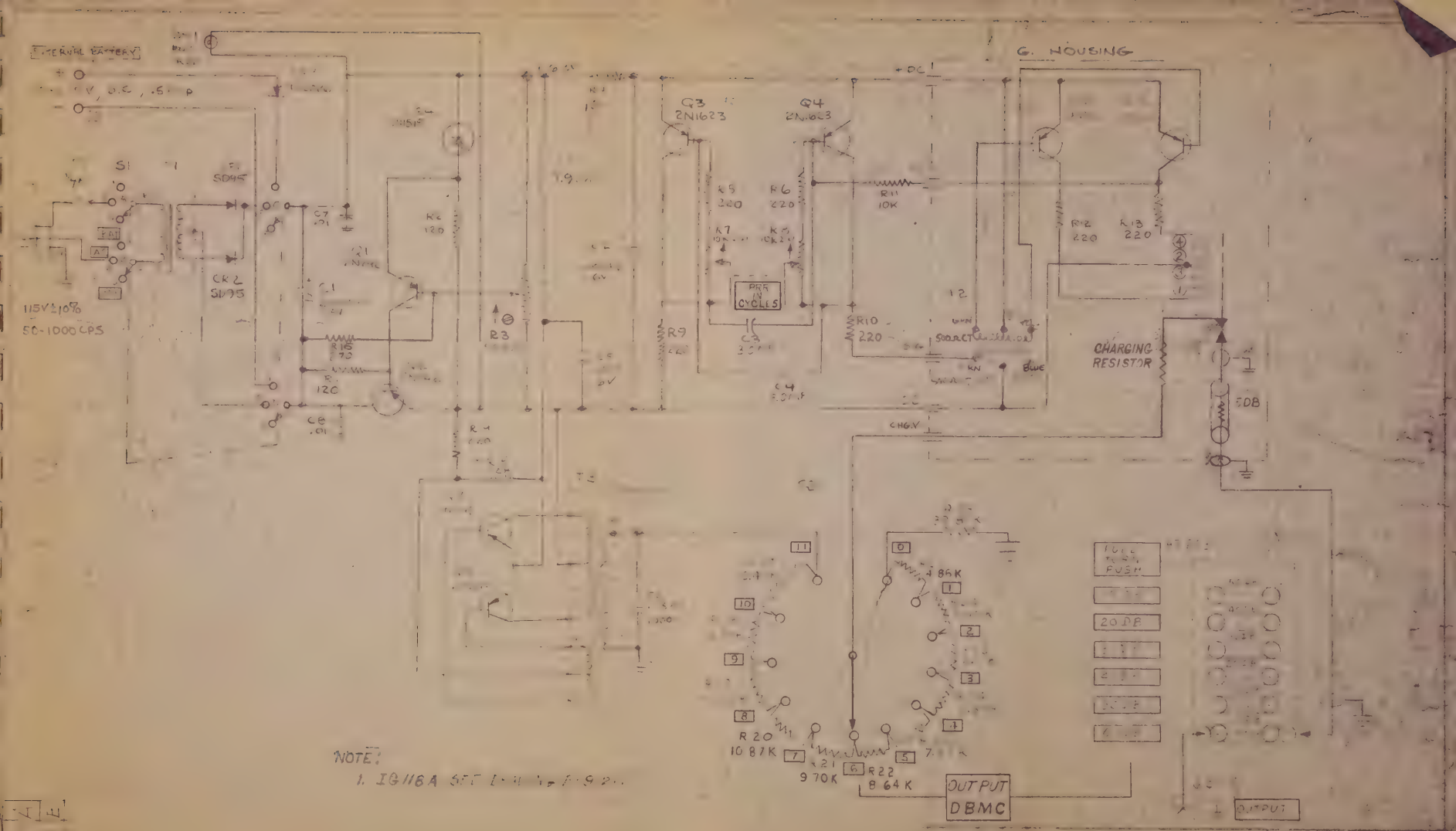
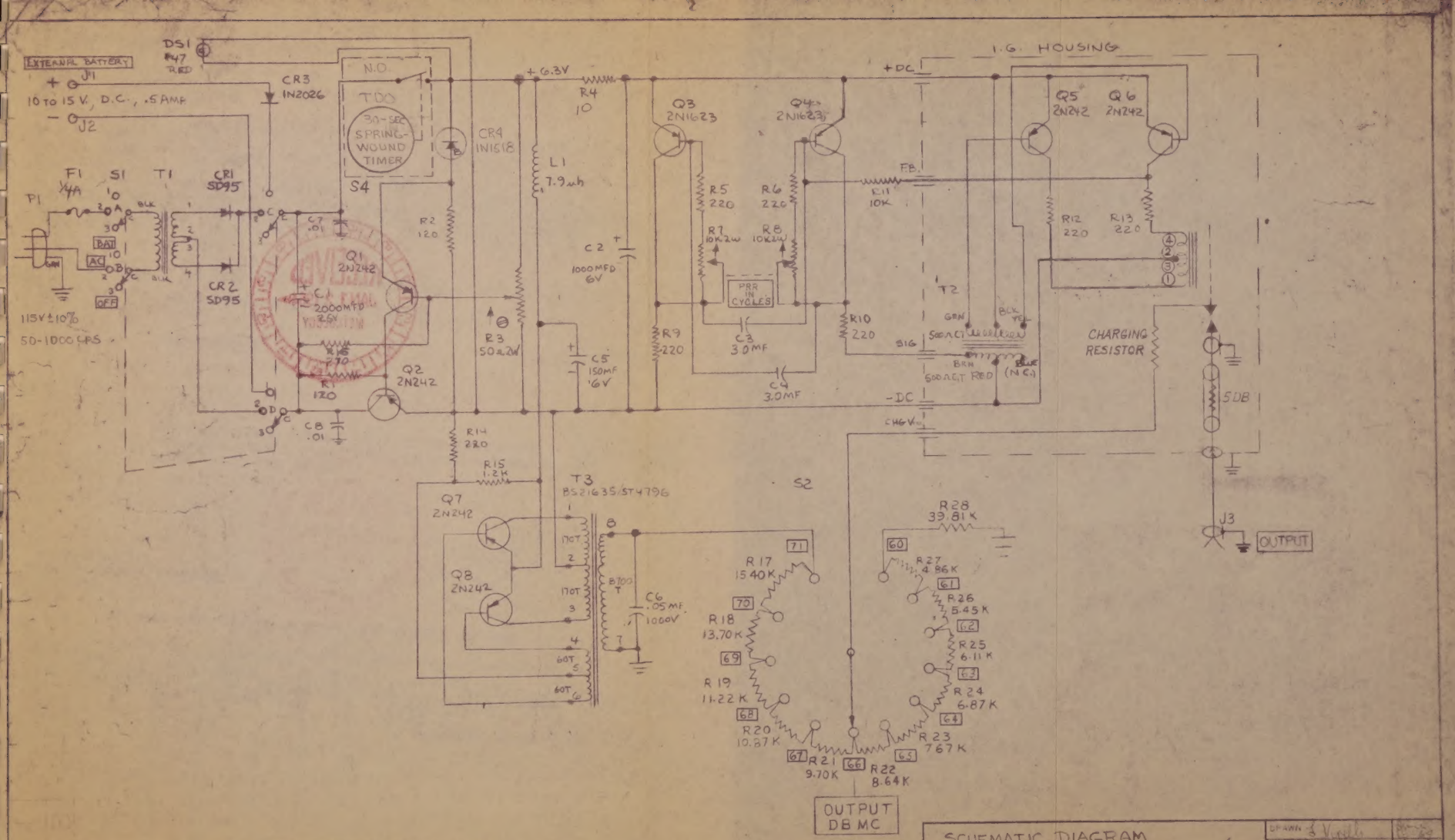

115V±10%
CR1 SD95
CR2 SD95
CR3 IN-128
T3
2N1302
2N1304
40K
R20 10.07K
R21 9.10K
R22 8.64K
CHARGING RESISTOR
J3
OUTPUT
OUTPUT DB MC
NOTE:
FOR IG 118 B SEE DRAWING B-9117.
SCHEMATIC DIAGRAM
IG-118A
C09181
B
PL 9100.


EXTERNAL BATTERY
+
12 V, D.C., .5 A
-
S1
SD45
FAN
AC
CR2
SD95
115V±10%
50-1000 CPS
C7 .01
C1 .1
R2 120
R15 470
R1 120
C6 .01
R3
R4 680
T2
R9 680
Q3 2N1623
Q4 2N1623
R5 220
R6 220
R7 10K
R8 10K
PRR IN CYCLES
C3 .01
R11 10K
R10 220
C4 .01
+DC
G. HOUSING
R12 220
R13 220
SOURCE
Blue
CHARGING RESISTOR
5DB
CHGV
C2
11
10
9
8
7
6
5
4
3
2
1
0
8.6K
R20 10.87K
R21 9.70K
R22 8.64K
20 DB
OUTPUT DBMC
OUTPUT
NOTE:
1. IG118A SET [illegible]
SCHEMATIC DIAGRAM
IG118B
PL 9100
009117
B

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REVISIONS

SCHEMATIC DIAGRAM
IG-118C

DRAWN J. Varallo
APP'D A. DeLeRus
CHK

THE SINGER CO.
METRICS DIV.
BRIDGEPORT CONN., U.S.A.

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|---|---|---|---|---|---|---|---|
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DATE

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